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**A HOUSING STARTS FORECASTING MODEL
FOR EDMONTON**

by

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IMPORTANT NOTE

This Technical Paper has been prepared by the Corporate Forecasting Group. Long Range Planning Branch, Planning and Building Department. The Paper documents research results as part of an ongoing forecasting activity. Neither the methods or results have been endorsed by the City of Edmonton.

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TABLE OF CONTENTS

PAGE

Acknowledgements

1.	Introduction	1
2.	The Edmonton Housing Starts Forecast Model: Initial Formulation	1
3.	Evaluation of the Initial Model	6
4.	A Revised Model	8
5.	Conclusions	9

	Bibliography	10
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Appendix A	Variables and Data (1972-1934)
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Appendix B	Housing Regressions (Annual Data)
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Appendix C	Housing Regressions (Quarterly Data)
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A HOUSING STARTS FORECASTING MODEL FOR EDMONTON

1. Introduction

At present, the Corporate Forecasting Group use a headship rate method to forecast housing starts. A housing forecast model using socio-economic variables is expected to provide a useful complement to this demographic-based approach. The purposes of this report are:

- i) to identify the factors affecting housing starts in Edmonton through development of a housing starts forecasting model;
- ii) to forecast Edmonton housing starts using the model;
- iii) to assess the advantages and desirability of the housing starts model.

Section 2 of this paper examines an initial formulation of a housing starts model. This section presents equations for each component of the model, and discusses the assumptions underlying each equation. A housing starts forecast is prepared in Section 3 using the model, and the results are discussed. Section 4 incorporates several revisions to the model and presents a forecast based on the revised model. The final section presents conclusions regarding the application of the revised model.

2. The Edmonton Housing Starts Forecasting Model: Initial Formulation

Initially, equations to forecast housing starts were developed and tested using quarterly data (see Appendix A), for the period 1971 to mid-1985. However, results obtained from this data were poor; therefore, annual data for 1972 to 1984 was used for the model specification. The results of tested equations using quarterly data are shown in Appendix C.

The Edmonton housing model consists of three components: single starts, multi starts (row and apartment housing) and total starts. Each equation shows the causal relationship between housing starts and their influencing factors. The theory explaining the causal relationship for each equation are discussed below.

A) Total Starts Equation

Maximization of profit is assumed as the objective of builders. Profit is determined by expected revenues and construction costs. Carrying costs are the most important component of the total cost. Similarly, high real mortgage rates weaken consumer demand for housing. Therefore, increases in real mortgage rates will depress the number of housing starts, while decreases in real mortgage rates increase housing starts.

High vacancy rates reduce the level of multi-housing starts, while low vacancy rates encourage starts. High vacancy rates discourage starts because of the likelihood of reduced rental income from row and apartment units.

Starts are also influenced by the rate of change in the price of new houses. When prices increase, more houses are started. Rising house prices lead to an increase in starts because higher prices imply greater profit to the builder and stimulate demand among prospective purchasers anxious to buy a house before the price increases further. Conversely, when prices decrease, fewer starts occur.

Because of the time required for planning and designing before a housing project is started, one to two year lags were tested for the above variables.

The relationship of total starts with the influencing variables described above is estimated and tested using the Ordinary Least Squares method. The resulting equation is shown below:

$$\begin{array}{ccccccc} \text{TS} = & - & 757. & - & 456.2636 & \text{RMR} & -412.575 & \text{VRL1} & +83.8561 & \text{RNPL2} \\ & & (-.16) & & (-2.27) & & (-1.51) & & (2.60) & \end{array}$$

$$R^2 = .878 \quad \text{SEE} = 1474$$

(EQUATION 1)

Where:

RMR = The five year mortgage rate adjusted for inflation, in percent.

VRL1 = The yearly average vacancy rate for apartments lagged one year in percent.

RNHL2 = The index value of the price of new single family housing lagged two years.

R^2 = Coefficient of determination

SEE = Standard error of estimates

The equation coefficients show that:

- i) For every 1% decrease in the real mortgage rate, 456 more starts occur.
- ii) For every 1% decrease in the apartment rental vacancy rate of the previous year, 412 more housing units are started.
- iii) For every 1 point increase in the real new housing price index of two years previous, 83 more housing starts occur.

The figures in the brackets are student's "t" statistic, indicating that the explanatory variables are statistically significant at least at the 90% level of confidence.

These variables account for 87.8% of the variation in the total housing starts between 1972 and 1984.

The results of other tested equations are in Appendix B. The other equations tested different variables or different lagged periods. These equations generally have a lower R^2 than Equation 1 and for this reason were not considered further.

B) Multi Starts Equation

Three variables are of influence in this equation: vacancy rates, real mortgage rates and population changes.

Vacancy rates and real mortgage rates operate in the same manner as described in the total starts equation. The number of multi-starts is also influenced by changes in Edmonton's population size; population increases result in more multi-starts.

The following equation shows the tested result of the above relationship:
These relationships are expressed in the following equation:

$$\begin{array}{ccccccc} \text{MS} = & 6953 & - & 589.6437 & \text{VRL2} & -535.8887 & \text{RMR} +.1445 & \text{PC} \\ & (6.69) & & (-3.36) & & (-3.95) & & (2.30) \end{array}$$

$$R^2 = .855 \qquad \text{SEE} = 1272.449 \qquad \text{(EQUATION 2)}$$

Where:

VRL2 = The yearly average vacancy rate for apartments lagged two years in percent.

RMR = The five year mortgage rate adjusted for inflation, in percent.

PC = Yearly change in Edmonton's population.

The equation coefficients show that:

- i) For every 1% decrease in the vacancy rate of two years previous, 589 more multi-units are started.
- ii) For every 1% decrease in the real mortgage rate, 535 more multi-units are started.
- iii) For every increase of 1,000 in Edmonton's population, 144 multi-units are started.

The "t" values show that the explanatory variables are statistically significant at the 97.5% level of confidence.

The three explanatory variables account for 85.5% of the variation in the multi-starts in Edmonton between 1972 and 1984. The equation shows that multi-starts are very sensitive to vacancy rates and real mortgage rates.

The results of other tested equations are in Appendix B. As with Equation 1, the other equations were not considered further because of their poorer explanatory nature.

C) Single Starts Equation

Two variables are of influence in this equation, real mortgage rates and real new house prices. These two variables operate in the same manner as described in the total starts equation.

Because of the time required for planning and designing before a housing project is started, one to two year lags were used for the above two variables in the equation.

The results of statistically estimating and testing the above relationships are shown below:

$$SS = 1837 - 326.1356 \text{ RMRL1} + 118.7406 \text{ RNHPL2}$$

$$(1.29) \quad (-3.43) \quad (2.02)$$

$$R^2 = .667 \quad SEE = 683.2 \quad (\text{Equation 3})$$

Where:

- RMRL1 = The five year mortgage rate adjusted for inflation, lagged one year, in percent.
- RNHPL2 = The index value of the price of new single family housing lagged two years.
- R^2 = Coefficient of determination
- SEE = Standard error of estimates

The equation coefficients show that:

- i) For a 1% decrease in the previous year's real mortgage rate, 326 more single family houses are started.
- ii) For a 1 point increase in the real new housing price index of two years previous, 18 more starts occur.

The "t" values indicate that the explanatory variables are statistically significant at 95% level of confidence.

The two explanatory variables account for 66.7% of the variation in the single family houses started between 1972 and 1984.

The results of other tested equations are in Appendix B. As with Equations 1 and 2, the other equations were not considered further because of their weaker explanatory power.

3. Evaluation of the Initial Model

The housing starts model discussed above relates housing starts to economic variables such as mortgage rates, inflation and vacancy rates. Forecasts of these variables are required for the housing starts forecasts. Forecasts of the economic variables used for the housing start forecasts for the period 1985-1987 are shown in Table 1.

Table 1
Forecast of Economic Variables Used in the Housing Model

	CPI (% Change)	Mortgage Rate (5 Year) (%)	Real Mortgage Rate (5 Year) (%)	Vacancy Rate (%)	Real New House Price Index	Population Change
1983(1)				8.5	111.4	
1984(1)	2.73	13.46	10.63	10.4	105.9	2,752
1985(1)	3.2	12.14	8.94	5.9	94.5	4,922
1986(2)	3.5	12.25	8.75	3.0	94.5	7,982
1987(2)	4.0	11.50	7.50	2.5	95.0	8,696

Sources: (1) Statistics Canada, CMHC, City of Edmonton, Planning and Building Department.
(2) City of Edmonton Planning and Building Department

Applying the above forecasts to the housing starts model the following results are obtained for Edmonton as shown in Table 2.

Table 2
Forecast of Housing Starts in Edmonton, 1985-1987

	Single Starts (Equation 3)	Multi Starts (Equation 2)	Total Starts (Equation 1)
1985 actual	1890	80	1970
1985 forecast	457	-2139	214
1986 forecast	906	-2715	1697
1987 forecast	754	711	2507

Note: Total starts figures are produced by a separate equation, not by combining single and multi starts.

None of the three components of the housing forecasting model give wholly satisfactory results. Of the three components, the total starts equation gives the most reasonable results overall. Although the exact values produced by the model are unlikely, the model does indicate what variables influence strongly housing starts in Edmonton.

Single starts are influenced most strongly by real mortgage rates and secondly by changes in the real price of new housing. Multi-starts are very sensitive to vacancy rates and real mortgage rates and, to a much lesser extent, to population increases. Total starts are largely determined by real mortgage rates, vacancy rates and, to a much lesser extent, by the real new house price. The model also shows that the influencing variables have their greatest effect when they are lagged.

4. A Revised Model

To improve forecasting ability, the original model was refined as below. The constant term value of -757 in the total starts equation (Equation 1) was changed to zero, because the t value obtained for the constant term was statistically insignificant. The modified equation is shown as follows:

$$TS = -456.2636 RMR -412.5753 VRL1 + 83.8561 RNHPL2$$

(EQUATION 4)

The value of the constant in the single starts equation (Equation 3) was changed so that the single starts equation would result in a figure equal to the actual number of single housing starts (1890) for the year 1985. The modified equation is shown below:

$$SS = 3269 - 326.1356 RMRL1 + 18.7406 RNHPL2$$

(EQUATION 5)

Figures for multi starts are obtained by calculating the difference between total starts and single starts; that is,

$$MS = TS - SS.$$

(EQUATION 6)

Housing starts forecasts using the revised model (Equations 4, 5 and 6) are displayed in Table 3.

Table 3
Housing Starts Forecast Using Revised Model

	Single Starts	Multi Starts	Total Starts
1986	2338	116	2454
1987	2186	1078	3264

5. Conclusions

The revised model produces forecasts which are close to those produced by methods based on demography (i.e., headship rates) (see the City of Edmonton Planning and Building Department, Housing Market Report, 1985). The model should be used, for the time being, for forecasting housing starts, but it should also be supplemented with forecasts based on the headship method. This will allow comparisons to be made and the most appropriate forecast can then be chosen.

Nonetheless, the model still needs further refinement. The improvements will include extending the period used for analysis as data becomes available and by testing additional explanatory variables.

BIBLIOGRAPHY

1. Whitehead, C.M. The U.K. Housing Market: An Econometric Model, Saxon House, London, 1974.
2. Smith, L.B. The Postwar Canadian Housing and Residential Mortgage Markets and the Role of Government, University of Toronto Press, Toronto, 1974.
3. City of Edmonton Planning and Building Department, Housing Market Report, 1985, Edmonton, 1985.
4. Eger, A.F. Forecasting Housing Starts in Canada's Census Metropolitan Areas: A Stock Adjustment Approach Using Unadjusted Seasonal Data, Canada Mortgage and Housing Corporation, May 1983

APPENDIX A

Historical Data, 1972 - 1984

Appendix A

(Variables and Data)

List of Variable Names

1.	S START	SINGLE STARTS
2.	M START	MULTI STARTS
3.	TOT START	TOTAL STARTS
4.	VAC RATE	VACANCY RATE
5.	ED UNEM R	EDMONTON UNEMPLOYMENT RATE
6.	R ABS M R	REAL MORTGAGE RATE
7.	S START L1	SINGLE STARTS LAG 1
8.	VAC RA L1	VACANCY RATE LAG 1
9.	VAC RA L2	VACANCY RATE LAG 2
10.	TOT STA L1	TOTAL STARTS LAG 1
11.	R MOR R L1	REAL MORTGAGE RATE LAG 1
12.	POPULATION	POPULATION INCREASE (EDMONTON)
13.	CONS COST	CONSTRUCTION COSTS (INDEX)
14.	NEW H IND	NEW HOUSE PRICE INDEX
15.	POP L1	POPULATION INCREASE LAG 1
16.	UNEM R L1	UNEMPLOYMENT RATE LAG 1
17.	UNEM R L2	UNEMPLOYMENT RATE LAG 2
18.	CON CO L1	CONSTRUCTION COST (INDEX) LAG 1
19.	NEW H L1	NEW HOUSE PRICE INDEX LAG 1
20.	NEW H L2	NEW HOUSE PRICE INDEX LAG 2
21.	R CON COS	REAL CONSTRUCTION COST
22.	R CO C L1	REAL CONSTRUCTION COST LAG 1
23.	R CO C L2	REAL CONSTRUCTION COST LAG 2
24.	U WA RA	UNION WAGE RATE
25.	U WA R L1	UNION WAGE RATE LAG 1
26.	R NEW H	REAL NEW HOUSE PRICE INDEX
27.	R NEW H L1	REAL NEW HOUSE PRICE INDEX LAG 1
28.	M START L1	MULTI STARTS LAG 1
29.	MURB	MULTIPLE UNIT RESIDENTIAL BUILDING PROGRAM
30.	CHOSP	CANADIAN HOME OWNERSHIP PROGRAM
31.	MURB L1	MULTIPLE UNIT RESIDENTIAL BUILDING PROGRAM LAG 1
32.	CHOSP L1	CANADIAN HOME OWNERSHIP PROGRAM LAG 1
33.	LNPOP	POPULATION (LOG VALUE)
34.	R NEW H L2	REAL NEW HOUSING INDEX LAG 2
35.	R MOR R L2	REAL MORTGAGE RATE LAG 2
36.	POP L2	POPULATION LAG 2
37.	SING ABS	SINGLE HOUSE ABSORPTION
38.	MULT ABS	MULTI UNIT ABSORPTION
39.	TOT ABS	TOTAL HOUSING ABSORPTION
40.	SING INV	SINGLE HOUSING INVENTORY
41.	MULTI INV	MULTI UNIT INVENTORY
42.	TOT INV	TOTAL HOUSING INVENTORY
43.	SI ABS L1	SINGLE HOUSE ABSORPTION LAG 1
44.	MUL ABS L1	MULTI UNIT ABSORPTION LAG 1
45.	TOT ABS L1	TOTAL HOUSING ABSORPTION LAG 1
46.	SI INV L1	SINGLE HOUSING INVENTORY LAG 1
47.	MUL INV L1	MULTI UNIT INVENTORY LAG 1
48.	TOT INV L1	TOTAL HOUSING INVENTORY LAG 1
49.	SI INV L2	SINGLE INVENTORY LAG 2
50.	MUL INV L2	MULTI INVENTORY LAG 2

11	5.65000	30109.00000	272.90000	137.20000	15432.00000
12	7.07000	8771.00000	303.30000	126.50000	30109.00000
13	7.40000	4374.00000	312.60000	123.60000	8771.00000

	Variable #16 (UNEM R L1)	Variable #17 (UNEM R L2)	Variable #18 (CON CO L1)	Variable #19 (NEW H L1)	Variable #20 (NEW H L2)
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OBS#					
1	5.20000	-9999999.99999	100.00000	40.60000	-9999999.99999
2	5.10000	5.20000	103.50000	44.40000	40.60000
3	4.70000	5.10000	122.50000	53.90000	44.40000
4	3.10000	4.70000	134.80000	70.20000	53.90000
5	4.00000	3.10000	145.40000	83.50000	70.20000
6	4.00000	4.00000	167.60000	100.00000	83.50000
7	4.20000	4.00000	194.50000	106.90000	100.00000
8	4.70000	4.20000	201.20000	114.30000	106.90000
9	3.70000	4.70000	219.20000	123.00000	114.30000
10	4.10000	3.70000	231.90000	132.70000	123.00000
11	4.10000	4.10000	256.80000	139.90000	132.70000
12	8.00000	4.10000	272.90000	137.20000	139.90000
13	12.10000	8.00000	303.30000	126.50000	137.20000

	Variable #21 (R CON COS)	Variable #22 (R CO C L1)	Variable #23 (R CO C L2)	Variable #24 (U WA RA)	Variable #25 (U WA R L1)
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OBS#					
1	107.20000	100.00000	-9999999.99999	112.00000	100.00000
2	112.70000	107.20000	100.00000	126.90000	112.00000
3	113.60000	112.70000	107.20000	141.20000	126.90000
4	117.90000	113.60000	112.70000	162.40000	141.20000
5	130.00000	117.90000	113.60000	193.40000	162.40000
6	133.00000	130.00000	117.90000	215.90000	193.40000
7	130.50000	133.00000	130.00000	230.70000	215.90000
8	127.00000	130.50000	133.00000	244.60000	230.70000
9	125.20000	127.00000	130.50000	265.70000	244.60000
10	122.10000	125.20000	127.00000	291.50000	265.70000
11	122.50000	122.10000	125.20000	323.90000	291.50000
12	131.20000	122.50000	122.10000	367.00000	323.90000
13	132.40000	131.20000	122.50000	380.40000	367.00000

	Variable #26 (R NEW H)	Variable #27 (R NEW H L1)	Variable #28 (M START L1)	Variable #29 (MURE)	Variable #30 (CHOSP)
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OBS#					
1	104.50000	100.00000	-9999999.99999	0.00000	0.00000
2	117.80000	104.50000	5113.00000	0.00000	0.00000
3	139.10000	117.80000	2409.00000	1.00000	0.00000
4	149.30000	139.10000	1412.00000	1.00000	0.00000
5	165.60000	149.30000	2951.00000	1.00000	0.00000
6	162.20000	165.60000	6536.00000	1.00000	0.00000
7	159.20000	162.20000	7444.00000	1.00000	0.00000
8	157.30000	159.20000	9234.00000	1.00000	0.00000
9	154.00000	157.30000	5544.00000	0.00000	0.00000
10	144.40000	154.00000	5255.00000	1.00000	0.00000
11	127.80000	144.40000	6471.00000	0.00000	0.00000

DATA 1972 - 1984

	Variable # 1 (S START)	Variable # 2 (M START)	Variable # 3 (TOT START)	Variable # 4 (VAC RATE)	Variable # 5 (ED UNEM R)
OBS#					
1	1651.00000	5113.00000	6764.00000	7.60000	5.10000
2	2313.00000	2409.00000	4722.00000	5.30000	4.70000
3	2355.00000	1412.00000	3767.00000	.80000	3.10000
4	3996.00000	2951.00000	6947.00000	.30000	4.00000
5	3723.00000	6536.00000	10259.00000	.01000	4.00000
6	3207.00000	7444.00000	10651.00000	.10000	4.20000
7	5434.00000	9234.00000	14668.00000	.80000	4.70000
8	4138.00000	5544.00000	9682.00000	1.90000	3.70000
9	3191.00000	5255.00000	8446.00000	1.10000	4.10000
10	4046.00000	6471.00000	10517.00000	1.10000	4.10000
11	1312.00000	7300.00000	9112.00000	4.00000	8.00000
12	3003.00000	2053.00000	5056.00000	8.50000	12.10000
13	1750.00000	127.00000	1877.00000	10.40000	14.10000

	Variable # 6 (R ABS M R)	Variable # 7 (S START L1)	Variable # 8 (VAC RA L1)	Variable # 9 (VAC RA L2)	Variable #10 (TOT STA L1)
OBS#					
1	4.61000	1338.00000	6.30000	5.70000	9451.00000
2	3.02000	1651.00000	7.60000	6.30000	6764.00000
3	1.38000	2313.00000	5.30000	7.60000	4722.00000
4	2.70000	2355.00000	.80000	5.30000	3767.00000
5	3.81000	3996.00000	.30000	.80000	6947.00000
6	1.33000	3723.00000	.10000	.30000	10259.00000
7	.48000	3207.00000	.10000	.10000	10651.00000
8	3.02000	5434.00000	.80000	.10000	14668.00000
9	4.24000	4138.00000	1.90000	.80000	9682.00000
10	5.65000	3191.00000	1.10000	1.90000	8446.00000
11	7.07000	4046.00000	1.10000	1.10000	10517.00000
12	7.40000	1812.00000	4.00000	1.10000	9112.00000
13	10.63000	3003.00000	8.50000	4.00000	5056.00000

	Variable #11 (R MOR R L1)	Variable #12 (POPULATION)	Variable #13 (CONS COST)	Variable #14 (NEW H IND)	Variable # 15 (POP L1)
OBS#					
1	4.00000	5266.00000	139.50000	44.40000	5514.00000
2	4.61000	835.00000	123.50000	53.90000	5266.00000
3	3.02000	3326.00000	134.50000	70.20000	835.00000
4	1.38000	5944.00000	145.40000	83.50000	3326.00000
5	2.70000	9924.00000	167.60000	100.00000	5944.00000
6	3.81000	9915.00000	184.60000	106.90000	9924.00000
7	1.33000	6592.00000	201.20000	114.30000	9915.00000
8	.48000	13293.00000	219.20000	123.00000	6592.00000
9	3.02000	14414.00000	231.90000	132.70000	13293.00000
10	4.24000	15432.00000	256.80000	139.90000	14414.00000

13	197.00000	290.00000	3010.00000	6146.00000	9156.00000
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Variable #46 (SI INV L1)	Variable #47 (MUL INV L1)	Variable #48 (TOT INV L1)	Variable #49 (SI INV L2)	Variable #50 (MUL INV L2)
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OBS#

1	-9999999.99999	-9999999.99999	-9999999.99999	-9999999.99999	-9999999.99999
2	146.00000	590.00000	736.00000	-9999999.99999	-9999999.99999
3	107.00000	361.00000	468.00000	146.00000	590.00000
4	168.00000	38.00000	206.00000	107.00000	361.00000
5	140.00000	41.00000	181.00000	168.00000	38.00000
6	139.00000	52.00000	191.00000	140.00000	41.00000
7	129.00000	854.00000	1043.00000	139.00000	52.00000
8	429.00000	828.00000	1257.00000	129.00000	854.00000
9	1302.00000	1705.00000	2007.00000	429.00000	828.00000
10	1248.00000	1148.00000	2396.00000	1302.00000	1705.00000
11	1302.00000	975.00000	2277.00000	1248.00000	1148.00000
12	727.00000	1459.00000	2186.00000	1302.00000	975.00000
13	190.00000	584.00000	774.00000	727.00000	1459.00000

12	111.40000	127.80000	7300.00000	0.00000	1.00000
13	105.90000	111.40000	2053.00000	0.00000	0.00000

	Variable #31 (MURB L1)	Variable #32 (CHOSP L1)	Variable #33 (LNPDP)	Variable #34 (R NEW H L2)	Variable #35 (R MOR R L2)
OBS#					
1	0.00000	0.00000	8.56903	-9999999.99999	-9999999.99999
2	0.00000	0.00000	6.72743	100.00000	4.00000
3	0.00000	0.00000	8.10953	104.50000	4.61000
4	1.00000	0.00000	8.69014	117.80000	3.02000
5	1.00000	0.00000	9.20271	139.10000	1.38000
6	1.00000	0.00000	9.20180	149.30000	2.70000
7	1.00000	0.00000	8.79361	165.60000	3.81000
8	1.00000	0.00000	9.49499	162.20000	1.33000
9	1.00000	0.00000	9.57596	159.20000	.48000
10	0.00000	0.00000	9.64420	157.30000	3.02000
11	1.00000	0.00000	10.31258	154.00000	4.24000
12	0.00000	0.00000	9.07921	144.40000	5.65000
13	0.00000	1.00000	8.38342	127.80000	7.07000

	Variable #36 (POP L1)	Variable #37 (SING ABS)	Variable #38 (MULT ABS)	Variable #39 (TOT ABS)	Variable #40 (SING INV)
OBS#					
1	-9999999.99999	1504.00000	6325.00000	7829.00000	146.00000
2	5266.00000	1665.00000	5712.00000	7377.00000	107.00000
3	335.00000	2941.00000	2931.00000	5772.00000	168.00000
4	3326.00000	2062.00000	1467.00000	3529.00000	140.00000
5	5944.00000	4300.00000	2365.00000	6665.00000	139.00000
6	9924.00000	3733.00000	6419.00000	10152.00000	189.00000
7	9915.00000	4101.00000	8298.00000	12399.00000	429.00000
8	6592.00000	4117.00000	6769.00000	10886.00000	1302.00000
9	13293.00000	3640.00000	5147.00000	9787.00000	1248.00000
10	14414.00000	4305.00000	5455.00000	9760.00000	1302.00000
11	15432.00000	2852.00000	6947.00000	9751.00000	727.00000
12	30109.00000	3010.00000	6146.00000	9156.00000	196.00000
13	3771.00000	2640.00000	1584.00000	4224.00000	93.00000

	Variable #41 (MULTI INV)	Variable #42 (TOT INV)	Variable #43 (SI ABS L1)	Variable #44 (MUL ABS L1)	Variable #45 (TOT ABS L1)
OBS#					
1	330.00000	706.00000	-9999999.99999	-9999999.99999	-9999999.99999
2	361.00000	468.00000	1504.00000	6325.00000	7829.00000
3	38.00000	206.00000	1665.00000	5712.00000	7377.00000
4	41.00000	181.00000	2841.00000	2931.00000	5772.00000
5	52.00000	191.00000	2962.00000	1467.00000	3529.00000
6	854.00000	1043.00000	4300.00000	2365.00000	6665.00000
7	828.00000	1257.00000	3733.00000	6419.00000	10152.00000
8	1705.00000	3007.00000	4101.00000	8298.00000	12399.00000
9	1148.00000	2396.00000	4117.00000	6769.00000	10886.00000
10	975.00000	2277.00000	3640.00000	5147.00000	8787.00000
11	1459.00000	2186.00000	4305.00000	5455.00000	9760.00000
12	584.00000	774.00000	2852.00000	6947.00000	9799.00000

APPENDIX B

Housing Regressions (Yearly Data)

APPENDIX B

TOTAL STARTS

1. Total
Starts = 8179.07782-736.85985 (Vacancy Rate L1) +.33154 (Total Starts L1)
(4.08) (-3.61) (1.76)
-224.37422 (Real Mortgage Rate)
(-1.13)
 $R^2 = .810$ SEE = 1745.914 DW = 2.57
2. Total
Starts = -757.59769-456.26362 (Real Mortgage Rate)
(-.16) (-2.27)
-412.57528 (Vacancy Rate L1) +83.85606 (Real New Housing L2)
(-1.51) (2.60)
 $R^2 .878$ SEE = 1474.483
3. Total
Starts = 13226.91119-1016.93009 (Vacancy Rate L2) -654.89617 (Real Mortgage Rate)
(12.97) (-5.22) (-3.77)
 $R^2 = .815$ SEE = 1711.784
4. Total
Starts = 11471.12326-1001.07208 (Vacancy Rate L1) -6.84626 (New Housing L1)
(5.57) (-4.93) (-.40)
 $R^2 = .727$ SEE = 1984.913
5. Total
Starts = 9438.47117-402.78480 (Real Mortgage Rate)
(.63) (-1.65)
-398.27762 (Vacancy Rate L1) -579.96950 (Vacancy Rate L2)
(-.85) (-1.34)
+19.17423 (Real New Housing L1)
(.21)
 $R^2 = .864$ SEE = 1664.916
6. Total
Starts = 2613.04672-466.41067 (Real Mortgage Rate)
(.27) (-2.17)
-391.67683 (Vacancy Rate L1) -204.72654 (Vacancy Rate L2)
(-1.33) (-.40)
+63.27857 (Real New Housing L2)
(1.02)
 $R^2 = .881$ SEE = 1558.984

7. Total
 Starts = 14215.51429-455.25677 (Real Mortgage Rate)
 (1.41) (-1.52)
 -511.62567 (Vacancy Rate L1) -651.90688 (Vacancy Rate L2)
 (-1.35) (-2.13)
 -9.75133 (Real New Housing)
 (-.16)

 $R^2 = .864$ SEE = 1667.084
8. Total
 Starts = 12588.26625-422.98003 (Real Mortgage Rate) -474.23048 (Vacancy Rate L1)
 (12.51) (-2.01) (-1.67)
 -645.45170 (Vacancy Rate L2)
 (-2.27)

 $R^2 = .863$ SEE = 1562.335
9. Total
 Starts = 6552.80944-662.10070 (Vacancy Rate L1)
 (.68) (-1.36)
 +.31952 (Total Starts L1) -229.31680 (Real Mortgage Rate)
 (1.51) (-1.08)
 +11.10386 (Real New Housing L1)
 (.17)

 $R^2 = .810$ SEE 1848.4157
10. Total
 Starts = -5585.03531-318.85041 (Real Mortgage Rate)
 (-1.39) (1.52)
 .28501 (Total Starts L1) +90.01223 (Real New Housing L1)
 (1.30) (2.99)

 $R^2 = .766$ SEE = 1934.433
11. Total
 Starts = 13226.91119-1016.93009 (Vacancy Rate L2) -654.89617 (Real Mortgage Rate)
 (12.97) (-5.22) (-3.77)

 $R^2 = .815$ SEE = 1711.784
12. Total
 Starts = 11471.12326-1001.07208 (Vacancy Rate L1) -6.84626 (New Housing L1)
 (5.57) (-4.93) (-.40)
13. Total
 Starts = 2059.42961+.68788 (Total Starts L1)
 (.81) (2.43)

 $R^2 .348$ SEE = 2924.780 DW = 1.327

14. Total
 Starts = 15621.46280-1212.07901 (Vacancy Rate L2)
 (4.46) (-3.59)
 -693.24996 (Real Mortgage Rate) -.20947 (Total Starts L1)
 (-3.72) (-.72)

 $R^2 = .826$ SEE = 1760.039
15. Total
 Starts = 13293.59165-450.79832 (Vacancy Rate L1)
 (3.58) (-1.39)
 -.05894 (Total Starts L1) -445.23106 (Real Mortgage Rate)
 (-.20) (-1.77)
 -718.71701 (Vacancy Rate L2)
 (-1.50)

 $R^2 = .864$ SEE = 1665.531
16. Total
 Starts = 12240.86683-408.88283 (Real Mortgage Rate L1)
 (9.66) (-1.16)
 -557.15301 (Vacancy Rate L1) -522.15753 (Vacancy Rate L2)
 (-1.60) (-1.66)
17. Total
 Starts = 2753.02847-809.14759 (Real Mortgage Rate)
 (1.09) (-3.05)
 +.35622 (Total Starts L1) +53.28310 (New Housing)
 (1.41) (2.08)
18. Total
 Starts = -8428.74367-84.12629 (Real Mortgage Rate)
 (-1.39) (-.29)
 +.50679 (Total Starts L1) +89.47936 (Real New Housing)
 (2.35) (2.36)

 $R^2 = .712$ SEE = 2148.948
19. Total
 Starts = -506.72603-659.06112 (Real Mortgage Rate)
 (-.05) (-3.97)
 -328.78846 (Vacancy Rate L2) +86.16011 (Real New Housing L2)
 (-.62) (1.38)

 $R^2 = .850$ SEE = 1632.722
20. Total
 Starts = 13226.91119-654.89617 (Real Mortgage Rate) -1016.93009 (Vacancy Rate L2)
 (12.97) (-3.77) (-5.22)

 $R^2 = .815$ SEE = 1711.784

21. Total
Starts = -13595.58826+157.08776 (Real New Housing L1) -4.18490 (Real New Housing L2)
(-3.61) (3.25) (-.09)

$$R^2 = .792 \text{ SEE} = 1816.718$$

22. Total
Starts = 2319.25935-151.42086 (Vacancy Rate L3)
(5.09) (-3.26)
-79.79090 (Edmonton Unemployment Rate) +.27062 (Total Starts L1)
(-2.24) (2.04)

$$R^2 = .625 \text{ SEE} = 741.586$$

23. Total
Starts = 1924.27840-158.98078 (Vacancy Rate L2) -30.49083 (Edmonton Unemployment Rate
L1)
(4.37) (-3.34) (-.72)
+34209 (Total Starts L1)
(2.65)

$R^2 = .606$ SEE = 760.1187

24. Total
Starts = 1924.06728-149.35143 (Vacancy Rate L2) -40.55799 (Edmonton Unemployment Rate L2)
(4.61) (-2.93) (-.88)
+.35125 (Total Starts L1)
(2.80)

$$R^2 = .608 \text{ SEE} = 758.142$$

25. Total
Starts = 2285.49416 - 308.09199 (Real Mortgage Rate)
(.38) (-1.12)
-561.86122 (Vacancy Rate L1) + 44.54183 (Real New Housing L2)
(-1.68) (.76)
+.27678 (Total Absorption)
(.81)

$R^2 = .888 \quad SEE = 1506.87$

26. Total
Starts = - 5589.45331 - 564.00842 (Real Mortgage Rate)
(-1.07) (-2.88)
-33.43293 (Vacancy Rate L1) + 140.18135 (Real New Housing L2)
(-.10) (3.06)
- .43074 (Total Absorption L1)
(-1.61)

$R^2 = .911 \quad \text{SEE} = 1347.64$

27. Total

Starts = - 3234.63885 - 479.25653 (Real Mortgage Rate)
 (-.55) (-2.29)
 -368.68296 (Vacancy Rate L1) + 105.82774 (Real New Housing L2)
 (-1.28) (2.37)
 -.52079 (Total Inventory)
 (-.74)

$R^2 = .887$ $SEE = 1518.442$

28. Total

Starts = - 2264.95458 - 426.65582 (Real Mortgage Rate)
 (-.41) (-1.97)
 -373.91549 (Vacancy Rate L1) + 96.32714 (Real New Housing L2)
 (-1.28) (2.42)
 -.38050 (Total Inventory L1)
 (-.59)

$R^2 = .884$ $SEE = 1538.564$

29. Total

Starts = 1310.94960 - 359.47742 (Real Mortgage Rate) - 518.26741 (Vacancy Rate L1)
 (.23) (-1.41) (-1.59)
 + 60.82754 (Real New Housing L2) + .20757 (Multiple Absorption)
 (1.26) (.66)

$R^2 = .885$ $SEE = 1528.760$

30. Total

Starts = - 4557.85771 - 572.01994 (Real Mortgage Rate)
 (-.81) (-2.59)
 -62.06210 (Vacancy Rate L1) + 122.63412 (Real New Housing L2)
 (-.15) (2.68)
 -.38675 (Multiple Absorption L1)
 (-1.17)

$R^2 = .898$ $SEE = 1442.324$

31. Total

Starts = - 3067.05160 - 481.72346 (Real Mortgage Rate)
 (-.50) (2.26)
 -365.51802 (Vacancy Rate L1) + 104.27602 (Real New Housing L2)
 (-1.24) (2.24)
 -.82650 (Multi inventory)
 (-.63)

$R^2 = .885$ $SEE = 1533.340$

32. Total

Starts = - 3550.30296 - 458.41188 (Real Mortgage Rate)
 (-.59) (-2.22)
 -288.28012 (Vacancy Rate L1) + 106.24939 (Real New Housing L2)
 (-.89) (2.40)
 -.92113 (Multi inventory L1)
 (-.76)

$R^2 = .887$ $SEE = 1514.376$

33. Total
 Starts = - 132.60054 - 292.69844 (Real Mortgage Rate)
 (-.02) (-1.06)
 - 549.10306 (Vacancy Rate L1) + 62.10287 (Real New Housing L2)
 (-1.63) (1.01)
 + .36411 (Total Absorption) - .71028 (Total Inventory)
 (1.03) (-.98)

 $R^2 = .904$ SEE = 1511.788
34. Total
 Starts = 961.93628 - 221.18858 (Real Mortgage Rate) - 548.78077 (Vacancy Rate L1)
 (.15) (-.74) (-1.60)
 + 51.35153 (Real New Housing L2) + .35785 (Total Absorption)
 (.85) (.89)
 - .55910 (Total Inventory L1)
 (-.83)

 $R^2 = .900$ SEE = 1540.96
35. Total
 Starts = - 5064.52783 - 576.36272 (Real Mortgage Rate)
 (-.89) (-2.73)
 + 37.66326 (Vacancy Rate L1) + 139.21363 (Real New Housing L2)
 (.09) (2.85)
 - .54872 (Total Absorption L1) + .38862 (Total Inventory)
 (-1.35) (.41)

 $R^2 = .913$ SEE = 1435.642
36. Total
 Starts = - 5453.00039 - 579.00091 (Real Mortgage Rate) - 21.42673 (Vacancy Rate L1)
 (-.96) (-2.49) (-.06)
 + 140.04570 (Real New Housing L2) - .45691 (Total Absorption L1)
 (2.84) (-1.36)
 .10855 (Total Inventory L1)
 (.15)

 $R^2 = .911$ SEE = 1452.781

MULTI STARTS

1. Multi
 Starts = 5850.76677-373.64565 (Vacancy Rate L1)
 (4.36) (-1.28)
 - 330.86258 (Real Mortgage Rate) + .14244 (Population)
 (-1.21) (1.29)

 $R^2 = .673$ SEE = 1801.569 DW = 1.51
2. Multi
 Starts = 5850.76677-373.64565 (Vacancy Rate L1)
 (4.36) (-1.28)
 - 330.86258 (Real Mortgage Rate) + .14244 (Population)
 (-1.21) (1.29)

3. Multi
Starts = 4741.42821+77.02160 (Vacancy Rate) -667.16672 (Real Mortgage Rate) +.26447
(Pop.)
(4.41) (.25) (-1.68) (2.66)
 $R^2 = .617$ SEE = 1951.386
4. Multi
Starts = 6126.21461-535.37129 (Vacancy Rate L1)
(4.28) (-1.64)
-152.26685 (Real Mortgage Rate L1) +.07735 (Population)
(-.38) (-.72)
 $R^2 = .626$ SEE = 1927.199
5. Multi
Starts = 5018.08403-169.37894 (Vacancy Rate)
(3.42) (-.56)
-410.22338 (Real Mortgage Rate L1) +.18482 (Population)
(-.81) (2.04)
 $R^2 = .531$ SEE = 2158.069
6. Multi
Starts = 8330.94786-750.27881 (Vacancy Rate L2) -475.33449 (Real Mortgage Rate L)
(7.49) (-3.69) (-1.94)
 $R^2 = .682$ SEE = 1776.459
7. Multi
Starts = 8810.64855-882.96666 (Vacancy Rate L2)
(6.37) (-2.95)
-299.16319 (Real Mortgage Rate L1) -.07870 (Population L1)
(-.79) (-.63)
 $R^2 = .697$ SEE = 1839.794
8. Multi
Starts = 5850.76677-373.64565 (Vacancy Rate L1)
(4.36) (-1.28)
-330.86258 (Real Mortgage Rate) +.14244 (Population)
(-1.21)
 $R^2 = .673$ SEE = 1801.569
9. Multi
Starts = 6988.60525-72.27146 (Vacancy Rate L1)
(6.26) (-.24)
-551.61607 (Vacancy Rate L2) -492.73592 (Real Mortgage Rate)
(-2.24) (-2.11)
+.13272 (Population)
(1.59)
 $R^2 = .856$ SEE = 1354.924

10. Multi
 Starts = 6953.04468 - 589.64373 (Vacancy Rate L2)
 (6.69) (-3.36)
 -535.88872 (Real Mortgage Rate) + .14449 (Population)
 (-3.95) (2.30)

 $R^2 = .855$ SEE = 1272.449
11. Multi
 Starts = 5347.77365 - 407.33541 (Vacancy Rate L2)
 (2.69) (-1.86)
 -462.26840 (Real Mortgage Rate) + .12630 (Population)
 (-2.62) (1.60)
 +.24380 (Multi Absorption)
 (.99)

 $R^2 = .784$ SEE = 1552.909
12. Multi
 Starts = 6959.83372 - 490.33261 (Vacancy Rate L2) - 527.96580 (Real Mortgage Rate)
 (4.47) (-2.07) (-2.95)
 +.15192 (Population) - .18974 (Multi Inventory)
 (1.52) (-.14)

 $R^2 = .758$ SEE = 1643.027
13. Multi
 Starts = 4901.88771 - 462.32785 (Vacancy Rate L2)
 (2.46) (-2.09)
 -454.43250 (Real Mortgage Rate) + .19064 (Population)
 (-2.62) (1.98)
 +.49632 (Multi Absorption) - 1.98639 (Multi Inventory)
 (1.50) (-1.13)

 $R^2 = .817$ SEE = 1527.346
14. Multi
 Starts = 7896.18416 - 595.98337 (Vacancy Rate L2)
 (5.57) (-3.34)
 -507.44152 (Real Mortgage Rate) + .14155 (Population)
 (-3.61) (2.22)
 -.18960 (Multi Absorption L1)
 (-.98)

 $R^2 = .870$ SEE = 1284.978
15. Multi
 Starts = 7266.18647 - 621.89144 (Vacancy Rate L2)
 (6.25) (-3.29)
 -502.92208 (Real Mortgage Rate) + .15119 (Population)
 (-3.37) (2.29)
 -.60769 (Multi Inventory L1)
 (-.72)

 $R^2 = .863$ SEE = 1322.379

16. Multi
 Starts = 7909.03344 - 594.46487 (Vacancy Rate L2)
 (4.86) (-2.92)
 -508.36404 (Real Mortgage Rate) + .14110 (Population)
 (-3.24) (1.97)
 -.19546 (Multi Absorption L1) +.03231 (Multi Inventory L1)
 (-.60) (.02)

$R^2 = .870$ SEE = 1387.873

17. Multi
 Starts = 6213.18617 - 563.78664 (Vacancy Rate L2)
 (3.14) (-2.63)
 -427.96152 (Real Mortgage Rate) + .14113 (Population)
 (-2.24) (2.00)
 +.19823 (Multi Absorption) - 1.00220 (Multi Inventory L1)
 (.67) (-.95)

$R^2 = .872$ SEE = 1377.231

18. Multi
 Starts = 7878.93146 - 605.74792 (Vacancy Rate L2)
 (5.05) (-2.38)
 -514.50149 (Real Mortgage Rate) + .14744 (Population)
 (-2.66) (1.21)
 -.13430 (Multi Inventory) - .17032 (Multi Absorption L1)
 (-.06) (-.44)

$R^2 = .870$ SEE = 1387.536

SINGLE STARTS

1. Single
 Starts = 3333.73484 - 449.77533 (Real Mortgage Rate L1) + 15.07266 (New Housing L1)
 (5.33) (-4.38) (2.49)

$R^2 = .672$ SEE = 710.312 DW = 2.98

2. Single
 Starts = 4457.27021 - 184.80957 (Vacancy Rate L1) - 212.27081 (Real Mortgage Rate L1)
 (10.14) (-2.11) (-1.67)

$R^2 = .631$ SEE = 752.696

3. Single
 Starts = 3137.27108 - 486.24893 (Real Mortgage Rate L1) + 25.73305 - .07209 (Pop.)
 (5.97) (-5.62) (3.81) (-2.35)

$R^2 = .796$ SEE = 589.202

4. Single
 Starts = 2342.79473 - 365.29514 (Real Mortgage Rate) + 29.85114 (New Housing
 L1) - .05948 (Pop.)
 (3.78) (-4.23) (3.39) (-1.60)

$R^2 = .694$ SEE = 723.015

5. Single
Starts = -1513.39509-122.26593 (Real Mortgage Rate L1) +41.62362 - .06526 (Population)
(-.91) (-1.15) (3.70) (-2.17)
 $R^2 = .789$ SEE = 599.710
6. Single
Starts = 120.97042-273.82418 (Real Mortgage Rate L1)
(.09) (-3.49)
+34.76599 (Real New Housing L2) -.07069 (Population)
(3.56)
 $R^2 = .818$ SEE = 543.370
7. Single
Starts = 2025.44012-339.36161 (Real Mortgage Rate L1)
(.91) (-2.22)
-3.36436 (Real New Housing L1) +21.13377 (Real New Housing L2)
(-.11) (.92)
 $R^2 = .678$ SEE = 724.049
8. Single
Starts = 379.30970-7.38995 (Real Mortgage Rate)
(.22) (-.06)
-218.19819 (Real Mortgage Rate L1) +26.06570 (Real New Housing L1)
(-1.18) (2.44)
 $R^2 = .680$ SEE = 739.477
9. Single
Starts = -789.96052-240.72691 (Real Mortgage Rate L1)
(-.17) (-1.19)
+192.34166 (Real Mortgage Rate L2) +30.26257 (Real New Housing)
(.82) (1.13)
 $R^2 = .596$ SEE = 810.523
10. Single
Starts = 1001.56796-267.44014 (Real Mortgage Rate L1)
(.38) (-1.51)
-8.76503 (Real New Housing) +31.45684 (Real New Housing L1)
(-.31) (1.52)
 $R^2 = .683$ SEE = 735.769
11. Single
Starts = 386.27123-226.52294 (Real Mortgage Rate L1) +26.01328 (Real New Housing L1)
(.23) (-2.05) (2.57)
 $R^2 = .680$ SEE = 701.661

12. Single
Starts = 1836.89662-326.13574 (Real Mortgage Rate L1) +18.74064 (Real New Housing L2)
(1.29) (-3.43) (2.02)
 $R^2 = .677$ SEE = 683.204
13. Single
Starts = -1418.30683-27.32091 (Real Mortgage Rate L2) +33.74472 (Real New Housing L1)
(-.47) (-.14) (1.92)
 $R^2 = .466$ SEE = 879.263
14. Single
Starts = 1466.19267-203.84232 (Real Mortgage Rate L2) +17.72211 (Real New Housing L2)
(.65) (-1.21) (1.27)
 $R^2 = .361$ SEE = 961.584
15. Single
Starts = -2675.87076-19.98562 (Real Mortgage Rate)
(-1.64) (-.24)
+48.14434 (Real New Housing L1) -.07639 (Population)
(4.14) (-2.21)
 $R^2 = .760$ SEE = 640.407
16. Single
Starts = -974.47582-170.99381 (Real Mortgage Rate)
(-.66) (-2.44)
+40.40329 (Real New Housing L2) -.06988 (Population)
(3.56)
 $R^2 = .738$ SEE = 653.049
17. Single
Starts = 1954.50830 - 303.90576 (Real Mortgage Rate L1)
(1.31) (-2.86)
+ 11.81772 (Real New Housing L2) + .23559 (Single Absorption)
(.76) (.57)
 $R^2 = .690$ SEE = 710.402
18. Single
Starts = 925.83557 - 353.99912 (Real Mortgage Rate L1)
(.59) (-3.72)
+28.42991 (Real New Housing L2) - .68132 (Single Inventory)
(2.38) (-1.23)
 $R^2 = .729$ SEE = 664.239
19. Single
Starts = 1055.04887 - 334.20996 (Real Mortgage Rate L1)
(.63) (-3.10)
+ 22.23460 (Real New Housing L2)

APPENDIX C

Housing Regressions (Quarterly Data)

$$\begin{array}{rcl}
 & (1.25) & \\
 + & .20025 \text{ (Single Absorption)} & - 65945 \text{ (Single Inventory)} \\
 & (.49) & (-1.13)
 \end{array}$$

$$R^2 = .738 \quad SEE = 698.186$$

20. Single
Starts = $449.14496 - 316.32601 \text{ (Real Mortgage Rate L1)}$
 $(.29) \quad (-3.64)$
 $+41.90476 \text{ (Real New Housing L2)} - .59724 \text{ (Single Absorption L1)}$
 $(2.59) \quad (-1.68)$

$$R^2 = .761 \quad SEE = 622.848$$

21. Single
Starts = $866.71470 - 278.77333 \text{ (Real Mortgage Rate L1)}$
 $(.52) \quad (-2.68)$
 $+26.50686 \text{ (Real New Housing L2)} - .58025 \text{ (Single Inventory L1)}$
 $(2.28) \quad (-1.08)$

$$R^2 = .718 \quad SEE = 676.704$$

22. Single
Starts = $-188.44292 - 279.96189 \text{ (Real Mortgage Rate L1)}$
 $(-.11) \quad (-2.89)$
 $+45.91862 \text{ (Real New Housing L2)}$
 (2.71)
 $- .54324 \text{ (Single Absorption L1)} - .45637 \text{ (Single Inventory L1)}$
 $(-1.49) \quad (-.90)$

$$R^2 = .786 \quad SEE = 630.193$$

23. Single
Starts = $78.72005 - 333.24399 \text{ (Real Mortgage Rate L1)}$
 $(.04) \quad (-3.32)$
 $+52.28951 \text{ (Real New Housing L2)}$
 (1.74)
 $- .19958 \text{ (Single Absorption)} - .71378 \text{ (Single Absorption L1)}$
 $(-.42) \quad (-1.53)$

$$R^2 = .767 \quad SEE = 657.694$$

24. Single
Starts = $-134.76700 - 339.80867 \text{ (Real Mortgage Rate L1)}$
 $(-.08) \quad (-3.81)$
 $+47.20999 \text{ (Real New Housing L2)} - .54838 \text{ (Single Inventory)}$
 $(2.81) \quad (-1.05)$
 $- .53295 \text{ (Single Absorption L1)}$
 (-1.49)

$$R^2 = .794 \quad SEE = 618.917$$

APPENDIX C

HOUSING EQUATIONS (Quarterly Data)

SINGLE STARTS

1. Single

Starts = $896.00729 - 34.74471$ (Vacancy Rate L3)
(5.65) (-2.38)
+ .20531 (Single Starts L1) - 40.30936 (Real Mortgage Rate L2)
(1.53) (-2.61)

$R^2 = .526$ SEE = 252.578

2. Single

Starts = $839.98058 - 38.78719$ (Vacancy Rate L3)
(4.98) (-2.55)
+ .23802 (Single Starts L1) 29.99676 (Real Mortgage Rate L3)
(1.69) (-1.69)

$R^2 = .490$ SEE = 262001 DW = 1.85

3. Single

Starts = $826.76273 - 31.02007$ (Vacancy Rate L3)
(5.83) (-2.12)
+ .27860 (Single Starts L1) - 39.44424 (Real Mortgage Rate L1)
(2.26) (-2.99)

$R^2 = .543$ SEE = 247.88 DW = 1.92

4. Single

Starts = $992.58080 - 73.88283$ (Real Mortgage Rate L1)
(13.16) (-3.73)
- 38.39937 (Vacancy Rate) + 37.09355 (Edmonton Unemployment Rate)

$R^2 = .438$ SEE = 276.943 DW = 1.42

5. Single

Starts = 548.62068+.45102 (Single Starts L1)

(3.73) (3.45)

-32.93058 (Real Mortgage Rate) -20.90080 (Vacancy Rate) +14.65809

(-1.70)

(-1.10)

(.76)

$R^2 = .440$ SEE = 277.284 DW = 2.18

6. Single

Starts = 1009.14283-73.73043 (Real Mortgage Rate L2)

(14.42) (-4.52)

-60.54622 (Vacancy Rate L3) +49.22877 (Edmonton Unemployment Rate L3)

(-4.28)

(2.79)

$R^2 = .571$ SEE = 240.229 DW = 1.76

7. Single

Starts = 581.32912+.44929 (Single Starts L1)

(4.15) (3.46)

-24.71026 (Real Mortgage Rate) -14.84970 (Vacancy Rate)

(-1.54)

(-.86)

$R^2 = .434$ SEE = 276.06

8. Single

Starts = 656.046-30.678 (Vacancy Rate) -8.064 (Edmonton Unemployment Rate

(3.98) (-.57)

(-.52)

148.514 (Vacancy Rate L1) -200.368 (Vacancy Rate L2)

(1.62)

(-2.11)

+44.505 (Vacancy Rate L3) +.381 (Single Starts L1)

(.77)

(2.75)

$R^2 = .518$ SEE = 261.991

9. Single

Starts = $1026.99792 + .15027$ (Nominal Mortgage Rate)
(16.43) (.57)
 $+95.96442$ (Real Mortgage Rate L1) -159.67678
(3.14) (-5.08)

$R^2 = .481$ SEE = 260.671

MULTI STARTS

1. Multi

Starts = $1346.826 + .282$ (Single Starts L1)
(3.76) (.85)
 $+27.447$ (Real Mortgage Rate) -156.206 (Vacancy Rate)
(.67) (-3.55)

$R^2 = .380$ SEE = 706.83 DW = 1.20

2. Multi

Starts = $1332.552 - 109.214$ (Vacancy Rate L3) -49.586 (Edmonton Unemployment Rate)
(4.51) (-2.79) (-1.27)
 $+ .326$ (Multi Starts L1) $+22.03951$ (Real Mortgage Rate L3)
(2.53) (.42)

$R^2 = .539$ SEE = 616.048

3. Multi

Starts = $1322.29525 - 103.38483$ (Vacancy Rate L3)
(4.53) (-2.85)
 -38.34016 (Edmonton Unemployment Rate) $+ .33241$ (Multi Starts L1)
(-1.36) (2.61)

$R^2 = .537$ SEE = 610.842 DW = 2.05

4. Multi

Starts = 1263.159-106.457 (Vacancy Rate L3) -110.727 (Edmonton Unemployment Rate)
(4.21) (-2.91) (-1.28)
+.349 (Multi Starts L1) +83.453 (Edmonton Unemployment Rate L1)
(2.71) (.88)

$R^2 = .544$ SEE = 612.209 DW = 2.06

5. Multi

Starts = 1281.89201-107.66006 (Vacancy Rate L3)
(4.25) (-2.93)
+.33494 (Multi Starts L1) -30.55218 (Edmonton Unemployment Rate L1)
(2.59) (-.98)

$R^2 = .529$ SEE = 616.151 DW = 2.072

6. Multi

Starts = 1366.61 -112.60 (Vacancy Rate L3)
(4.56) (-2.92)
-59.10 (Edmonton Unemployment Rate) +.310 (Multi Starts L1)
(-1.49)
+33.77 (Real Mortgage Rate L1)

$R^2 = .542$ SEE = 613.63

7. Multi

Starts = 1885.431 +.851 (Real Mortgage Rate L2)
(9.75) (.02)
-156.253 (Vacancy Rate L3) -42.220 (Edmonton Unemployment Rate L3)
(-4.00) (-.87)

$R^2 = .453$ SEE = 663.81

TOTAL STARTS

1. Total

Starts = 2131.426 -52.850 (Edmonton Unemployment Rate)
(4.93) (-1.10)
-141.991 (Vacancy Rate L2) +.310 (Total Starts L1)
(-2.96) (2.44)
-18.449 (Real Mortgage Rate L3)

$$R^2 = .623 \text{ SEE} = 751.101 \text{ DW} = 2.04$$

2. Total

Starts = 2120.867 -61.429 (Edmonton Unemployment Rate)
(4.97) (-1.64)
-145.777 (Vacancy Rate L2) +.313 (Total Starts L1)
(-3.19)

$$R^2 = .622 \text{ SEE} = 744.041$$

3. Total

Starts = 3029.011 -84.486 (Real Mortgage Rate L2)
(13.08) (-1.56)
-201.312 (Vacancy Rate L3) -32.434 (Edmonton Unemployment Rate L3)
(-4.30) (-.55)

$$R^2 = .569 \text{ SEE} = 795.209 \text{ DW} = 1.20$$

4. Total

Starts = 2037.668 + .685 (Single Starts L1) -14.973 (Real Mortgage Rate)
(4.72) (1.71) (-.30)
-190.837 (Vacancy Rate)
(-3.60)

$$R^2 = .505 \text{ SEE} = 851.978 \text{ DW} = 1.45$$

5. Total

Starts = 3096.43610 - 15.912 (Vacancy Rate) - 249.557 (Edmonton Unemployment Rate)
(12.53) (-.09) (-1.99)
+100.917 (Vacancy Rate L1) - 184.758 (Vacancy Rate L2)
(.33) (-.62)
-112.124 (Vacancy Rate L3) +136.954 (Edmonton Unemployment Rate L1)
(-.66) (.79)
+31.497 (Edmonton Unemployment Rate L2)
(.22)

$R^2 = .605$ SEE = 786.096